

Efficacy Of Content And Language Integrated Steam Based Learning Environment On English Language Acquisition Among High School Students

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ABSTRACT

The present study investigates the relationship between scientific temper and student engagement and English Language Acquisition among students of standard IX studying under the Tamil Nadu equitable education syllabus. An experimental method is used to select a sample of 64 students. The research tools used are Scientific Temper adapted from (Tiwari and Pande, 2006) and modified by the researcher, Student Engagement (Chiu et al., 2006) adapted and modified by the investigator. The intervention used in the classroom consisted of Content and Language Integrated Learning (CLIL), in a STEAM (Science, Technology, Engineering, Arts and Mathematics) based environment in order to find importance of English language acquisition which is one of the most important skills required for learning any body of knowledge in the present scenario. The results of statistical analyses show significant correlation between Scientific Temper and Student Engagement among the students pertaining to their English Language Acquisition. This implies that these factors play a crucial role in English Language Acquisition among students.

KeyWords: Scientific Temper, Student Engagement, English Language Acquisition, CLIL, STEAM

1. Introduction

In a rapidly evolving educational landscape, integrating topic knowledge with language competency is progressively becoming vital to foster a comprehensive development of pupils. Built on the theoretical framework and pedagogical Constructed upon the theoretical milestones of the chosen variables holds Scientific Temper as a foundational disposition that changes the way students understand complex, content-integrated tasks- especially in English-medium environments where language and content learning occur at the same time.

When students display characteristics such as curiosity, rational inquiry, and open-mindedness, it is more possible that they would engage meaningfully with classroom activities, thereby exhibiting greater levels of Student Engagement. This in turn, becomes a key factor for English Language Acquisition. By analysing the interrelationships among these variables, this study aims to uncover the how Scientific Temper and Student Engagement jointly contribute to language development within content-driven learning contexts.

2. Need for the current research

Scientific Temper plays a vital role in school education, social progress and the development of the nation. This is emphasized in the Indian Constitution where, the cultivation of scientific temper is declared as the fundamental duty, playing a key role in creating inquiry-driven and rational citizens. In the present world filled with misleading information from various sources like social media, especially through the use of pseudoscience. Research in the field of scientific temper shall help in designing of tools and pedagogical practices to assess the same among both learners and educators. On the other hand, Student engagement is also becoming more and more significant in educational research since it has such a big impact on how well students do in school, and how accounting for all or many of their educational outcomes could be neglected

by the learners (Fredricks, Blumenfeld, and Paris, 2004). It implies how much students are interested in, dedicated to, and invested in their schoolwork and education as a whole. Engagement is crucial not just for performing well in school right now, but also for staying in school, keeping motivated, being strong, and being psychologically well in the long run (Skinner and Pitzer, 2012). In order to attain the above in the modern educational world, new intervention techniques such as CLIL in STEAM based environment needs to be adapted to make it easily achievable to test both scientific temper and student engagement.

3. Review of Related Literature

Studies reviewed pertaining to the present study have been compiled and presented below under the appropriate headings.

3.1 Studies related to English Language Acquisition

Duursma et al (2007) studied how the language and literacy environment at home affects how bilingual children learn new words. The study looked at how having books at home and how often parents read to their wards affected the vocabulary of 96 fifth grade. Latin English Language Learners (ELLs) who spoke both languages. The study indicated that kids who had parents who read to them a lot and lived in homes that were rich in reading had considerably superior vocabulary skills in both English and Spanish. The study looked at how crucial it is for parents to be involved and have access to reading resources in order to assist the learning. This would help them learn two languages.

Quiroz et al. (2010) investigated at how giving mothers and children at home opportunities to read and talk to each other in both Spanish and English affects the vocabulary of bilingual students. The study looked at bilingual household and how reading together and teaching children to read at home affected their vocabulary. There was no information on the actual sample size. The results showed that bilingual youngsters learnt new words better when their moms and children got along well, especially when they read and chatted about texts together. The study focused on interactive literacy activities at home and encouraged parents to read with their child often and make the house a welcome place for learning to read and write in two languages.

Puri (2015) investigated English language learning in tribal areas like Chandrapur has been greatly affected by the cultural, socio historical and linguistic backgrounds of the era. He states that while English is a second language in the majority of Indian states, in many tribal cultures it is still observed and dealt with as a foreign language because of inadequate knowledge and functional use. Indian education policy's three-language formula hoped to incorporate English into school curricula, yet its application in tribal areas is still insufficient. He suggests bilingual teaching approaches, integration of ICT, and training of teachers to overcome this limitation. Therefore, recent literature emphasizes the need for contextually adapted, inclusive, and culturally sensitive English pedagogy for tribal students.

Shneyderman (2021) wrote a study for Miami-Dade County Public Schools that inspect how 49,201 English Language Learners (ELLs) in grades K–12 improved their English language and instruction skills through the 2020–2021 school year. This research looked at students' demographic data, their scores on state evaluation, and their English language skills as determined by ACCESS for ELLs. The study showed that just 20% of the ELLs were proficient at English and only 10% were prepared to exit the ESOL training. The maximum developments stood in the Listening assessment area (73%), while the minimum were in the Writing assessment part (23%). Present ELLs did worse on standardised assessments like the FSA and EOC than their equals who were ELLs before. It was obvious that "previously" meant a comparison group and not a trial sample. Many students have been ELLs for a long time. The proportion went up from 13% in 2019–2020 to 16% in 2020–2021. Results indicate how crucial it is to keep an eye on ELLs and give them one-on-one academic aid to help them get better at English and perform well in school.

The study on influence of native language on English language acquisition by Seema Rani (2023) looks at how Hindi, the first language of Indian pupils, influences their capacity to learn English. The essay talks about the language, phonetic, syntactic, and cultural difficulties that make it hard to acquire English in India's multilingual environment. The study talks a lot on how languages mix in India, showing how English changes to fit different locales through vocabulary and idioms, which is typically due to the culture and media in those areas. The author says that being proficient at English is very important for moving ahead in Indian society, which makes parents want their kids to learn English first. The conclusion offers a way of teaching Hindi speakers that includes a variety of different things, such learning in context, being alright with making mistakes, obtaining feedback, and knowing about other cultures. Dr. Rani's research helps us understand how acquiring a second language and our first language affect each other in complicated ways. It gives instructors and language planners good ideas about how to teach.

Evaluation

Studies from around the world and India on English Language Acquisition (ELA), indicate that there is a lot of research that is continually evolving and becoming more useful in schools that speak more than one language, are diverse, and are always changing with technology. These studies teach us a lot about how people learn English in both formal and informal settings. But they also show us critical gaps, especially when

it comes to employing new modes of learning like project-based learning (PBL), inquiry-based learning, and immersion pedagogy.

3.2 Studies related to Scientific Temper and English Language Acquisition

Kour (2015) studied the connection between scientific temper and academic success among high school girls in Srinagar, India, in 2015. The study used Nadeem and Rashid's Scientific Temper Scale to examine at 120 teenage girls. Half of them were great achievers and half of them were low performers. You could tell whether someone had a scientific temper by how curious, open-minded, objective, reasonable, and anti-superstitious they were. The results demonstrated that curiosity, objectivity, and rationality were very different in three primary domains. It reveals that pupils who have a scientific mentality may do better in school. Kour says that to assist pupils develop a scientific attitude, they should do science courses that are based on activities and questions, as well as science fairs and model-making outside of school. This study presents a stronger case for making scientific temper a key goal of education for the full development of students.

Gopalkrishnan and Galande (2021) looked closely at how urban Indian millennials deal with the idea of scientific temper in a time when they are consuming a lot of news and social media. They used a descriptive, stratified sample to look at the differences between Gen Z students from different schools (science vs. non-science) and how much digital media they were exposed to. The study indicated that pupils who had studied science were always more interested in science than students who had not studied science. It also revealed that science-stream students who read a lot of news and used social media didn't always lose their capacity to think clearly. The writers thought that teaching science made people less likely to believe erroneous information, even when they see a lot of it online. They also said that cultural myths and school rules that make science seem like a myth affect how individuals think about science.

Chakraborty and Giuffredi (2023) investigated a study on reconceptualizing Scientific Temper for Global Science Communication. They made a conceptual intervention by suggesting that scientific temper should be used as a global communication framework, which is very much based on Indian social and political traditions. It sees scientific temper as a philosophy that is built on Nehruvian values and the Constitution and gives people authority. The authors believe that we need to modify the curriculum, offer teachers additional training, and come up with national communication techniques that foster reasonable inquiry in order to make scientific temper a part of science education and public discourse. This theoretical intervention expands the field of scientific temper scholarship by showing that it can be a valuable approach to teach and talk about science, policy, and public reason.

Suna and Meher (2023) looked at scientific temper among Indian undergraduate students across different demographic groups, such as gender, stream, location, family type, religion, and caste. They used the standardized Scientific Temper Inventory to survey 108 pupils and compare the means of the different groups. The results showed that the sample had a scientific temper that was higher than usual. Kids in cities scored higher than kids in rural areas, while pupils from joint families showed better temper. Their results show that we need strategies that include students from rural areas and nuclear families in structured science outreach and education initiatives. They also say that prejudice that is peculiar to a certain stream may not affect how scientific attitudes are formed. This study adds to the body of research on participation by illustrating how social and cultural factors affect scientific thinking and rational inquiry in different groups of people.

Evaluation

The reviewed studies show the multipronged nature of scientific temper, displaying the way in which it is shaped by demographic, cultural, educational and institutional aspects. Experimental findings, especially by Suna and Meher (2023), Kour (2015), and Pandey and Biswal (2021) confirm that while the stream of study and gender do not show significant differences, familial aspects, lifestyle factors and academic achievement and performance can change the levels of curiosity, rationality and objectivity. These studies highlight that scientific temper is not just a personal trait but is deeply ingrained in social settings, teaching practices and the level to which a learner is exposed to inquiry-driven learning. Conceptual intervention-based studies, like those by Gholam (2019) and Wilson (2020), emphatically place systemic barriers including pedagogy and lack of teacher readiness that they claim to limit the growth of logical thinking, whereas hands-on approaches encourage questioning and evidence-based reasoning.

3.3 Studies related to Student Engagement and English Language Acquisition

Phuntsho and Dhendup (2020) studied how Bhutanese high school students felt about the school climate and how those feelings affected how involved they were and how well they did in school. There were 212 kids in grades 9–12, and things like support, safety, and peer interactions at school were substantially linked to how engaged they were. Engagement also connected climate and achievement. This means that schools and classrooms that are helpful make students more interested in both their minds and their feelings, which helps them do better in school. The results reveal that the climate at the school level affects how engaged and successful students are in high school.

Li et al. (2022) studied English-major teacher training students in China who will go on to teach in high school. They studied the connections between the classroom environment, student involvement, and academic success. Path analyses showed that a supportive environment (like teachers helping with schoolwork, students respecting each other, and students interacting with each other) made students more likely to be engaged, which partly explained how it affected their performance. The results show that pleasant surroundings make people want to participate in classrooms like the ones they will teach, even if they are not secondary-level students themselves. 27% of the difference in engagement could be explained by the classroom atmosphere, and 19% of the difference in academic achievement could be explained by both climate and engagement.

Evaluation

Taken together, these studies show that student engagement is driven less by generic “teacher support” in the abstract and more by specific psychological processes (need satisfaction, positive emotions, perceived competence) and by the fit between pedagogy, task type, and context. Irrespective of the fact that there is a vast body of research on student engagement (Fredricks, Blumenfeld, and Paris, 2004; Appleton, and Furlong, 2008), there remains an obvious dearth of studies that is proportionally in connection with student engagement. Much of the present literature throws limelight on academic achievement while language acquisition research often emphasizes on cognitive and sociolinguistic factors. Therefore, there is a need for integrated investigations that bring together frameworks of engagement and second language acquisition for better cognition of long-term language development.

3.4 Studies related to Content and Language Integrated Learning (CLIL) and English Language Acquisition

Coonan (2008) discusses the problematic ways that foreign languages are employed in CLIL (Content and Language Integrated Learning) lessons. He focusses on the methodological and pedagogical problems that come up while trying to encourage good oral language development. Coonan looks at the results of five classes from research done in four Italian high schools. She employs detailed transcribing and analysis methodologies, focused on the AS-unit structure to figure out how much and how well students speak. The results reveal that students do use spoken language in CLIL classes, but they don't use it very much or in very complex ways, and many of their sentences aren't grammatically correct. It's fascinating to see that students spoke more while they worked in groups or pairs than when they were taught by an instructor. The study reveals how crucial it is to give students more structured chances to practise speaking. It also highlights how important it is for teachers to assist pupils pay attention to language form, especially vocabulary and structure.

Mehisto et al. (2008) shows that the CLIL technique works effectively in schools with a lot of evidence. The results suggest that kids who take part in CLIL programs get a lot better at all of their language skills, like reading, writing, listening, and speaking. These improvements came from using language in a meaningful way in content-based settings. This makes people want to utilise language in a natural and helpful way. Also, mixing language and subject matter helps pupils understand ideas better, which helps them learn more difficult academic content on a deeper level. This dual focus helps people think more deeply and makes it simpler to integrate language and learning. The study also found that students are more interested and motivated in CLIL settings since they can see how their language abilities may be employed in real life. The tasks are authentic and have a point, which makes the students more interested in and thrilled about learning both language and content. Another key outcome is that people's cultural and intercultural skills have improved. When students work with peers from other backgrounds and learn from each other, they learn more about other cultures and get better at talking to people from those cultures. The study uses data from a lot of various research sources, which makes the conclusion that CLIL is a very good approach to teach even stronger. These results show that CLIL should be utilised more often in school to help kids learn and progress in all areas in a world that is more linked.

Möller (2017), does a thorough analysis of how people acquire languages in both Content and Language Integrated Learning (CLIL) and non-CLIL situations. The study looks at how people acquire passive structures, which are a sort of grammar that can be challenging for students to get. The study paints a fuller picture of language development by adding learner characteristics and cognitive aspects that are generally left out of classic LCR. By comparing the two groups, the research demonstrates that CLIL and non-CLIL groups have different tactics and results. The study's results have real-world consequences, suggesting that CLIL may help students learn hard grammatical rules in a way that is more useful and meaningful. This can help teachers find better ways to teach languages. The study also implies that we need to learn more about how different ways of teaching affect different areas of learning a language. This will assist create a foundation for additional new ideas and theories in SLA.

Lanvers (2019) attempts to bring together the theory and practice of Second Language Acquisition (SLA) and Learner Corpus Research (LCR). They achieve this by coming up with a new technique to see how well Content and Language Integrated Learning (CLIL) performs in classrooms. It is very helpful to combine SLA and LCR since it provides us a better understanding of how language grows, especially when we look at the implications of CLIL. One of the most important new things about the research is that it uses both learner

corpus data and experimental data from the same sample of learners. Using two sets of data in this way gives us a better and more complete picture of how people learn languages. The study paints a more thorough and critical picture of CLIL's involvement in language instruction in this way. The study looks at the English passive voice from a linguistic point of view, examining how this grammatical structure is employed in both CLIL and non-CLIL teaching materials and how this influences what students write. This precise focus makes the results more accurate and helps teachers plan better grammar sessions.

Calderón et al. (2022) say that Content and Language Integrated Learning (CLIL) is very significant for making English language instruction better, especially because it conforms with the Common European Framework of Reference for Languages (CEFRL). The study reveals that CLIL helps people learn languages better by integrating language lessons with interesting content. It does this by paying attention to two things at once. This integration enables students apply the language in real life, which makes them more motivated and improves their overall skills. The report also indicates that teachers of languages should keep studying and growing better at what they do. The study claims that CLIL is a great way to educate since it not only helps students learn languages better, but it also makes the process of learning more fun and relevant to their life.

.Pratap et al. (2022) looked at how merging topic areas with English language instruction affects how students learnt English in Indian classrooms in a study named "CLIL: An Integrated Learning Strategy for English Language Learning." The study was done in Tamil Nadu with high school students. It employed a quasi-experimental approach to compare CLIL-based instruction to more traditional ways of teaching language. We gathered the information by giving pupils tests on vocabulary, understanding, and remembering what they learnt before and after the study. The results indicated that the CLIL group got a lot better at speaking and writing without harming their capacity to learn new things. Students were more interested, and they learnt a lot more about how to use English in many settings. The study indicated that CLIL could be helpful for bilingual education in India and said that schools should employ it more often. It also underlined how important it is to train teachers and provide bilingual resources that are relevant to India.

Evaluation

The literature study on English Language Acquisition (ELA) and Content and Language Integrated Learning (CLIL) in both international and Indian settings demonstrates that CLIL is becoming more and more accepted as a good technique to teach bilingual and multilingual students. When you put all the research together, you can see that CLIL helps students learn more about the subject, stay interested, and learn in scenarios that are more like the actual world. These are positive indicators, but there isn't enough research on how to apply CLIL in inquiry-based learning, project-based learning (PBL), immersion contexts, and other content-based language learning methods.

3.5 Studies related to STEAM (Science, Technology, Engineering, Arts and Mathematics) and English Language Acquisition

Chapman (2020) discussed on the use of STEM-related books to educate English students how to understand figurative language. The study, which was done informally with high school English teachers and students, looked at how reading scientific articles, biographies of innovators, and speculative science fiction books affected them. Chapman used qualitative comments and samples of student work to show that STEM books helped students learn new terminology, think more critically, and connect what they learnt in multiple courses. One assignment was to look at how figurative language was utilised in stories about scientific achievements. This helped pupils link literary methods to technical facts. The study's classroom-based findings suggest that literature can help students comprehend and enjoy science by putting it in a context. Chapman thinks that science-themed literature should be used as anchor elements in ELA units and that science teachers and ELA teachers should work collaboratively. The strategy makes students see the humanities and sciences as parts of a whole that work together to make a well-rounded intellect, not as separate subjects.

Jetton et al. (2021) looked at the research on how reading and writing can be employed in STEM/STEAM education in a systematic way. The researchers looked at more than 50 real-world studies from 2005 to 2020 and utilised a qualitative content analysis approach to categorise the types and effectiveness of literacy-based treatments in STEM contexts. The research revealed that the top programs taught argumentative writing, journal reflections, and technical reading through project-based learning. STEM and English Language Arts teachers required to work together across subjects for the initiative to be successful. The authors underlined that mixing reading with STEM courses makes it easier to understand ideas, analyse critically, and talk about things in those domains. One important problem that was observed is that teachers don't get adequate training on how to do these integrations successfully. The study showed that reading and writing are not just nice to have; they are crucial for deep learning in STEAM. It advises modifying the curriculum so that maths and science classes focus on real-world literacy problems. It also suggests making evaluation rubrics that look at both content and literacy abilities.

Wahyuningsih et al. (2022) looked into how adding arts to STEM education could help bilingual students in the US learn more about science. The study looked at how STEAM teaching methods could assist students acquire scientific language by employing different ways to explain abstract ideas. The study discovered that students used movement, gestures, and stories to show scientific words and ideas in both words and actions. Students were able to acquire more language and understand ideas better with this strategy. The authors considered that these results showed that embodied cognition and tasks with numerous representations can lessen cognitive load. This can free up more resources for executive functioning, such as working memory capacity. The study says that using arts-based methods in STEM classes can help bilingual students learn better and make things fairer.

The SSRVM Trust (2023) talked about how to use STEAM education at the best schools in India. They talked about how to include the arts in STEM programs so that kids may learn more. The essay didn't mention how many people were in the sample or employ empirical methodologies, but it did present some important information based on what the author saw and how things are done at the school. Creative writing, poetry, and drama were some of the activities that combined language arts with science and arithmetic. The objective of this strategy was to assist pupils get better at becoming emotionally intelligent, creative, and critical thinkers. The trust saw that adding arts to STEM disciplines made pupils more motivated and helped them understand hard concepts better. It says that schools should employ STEAM approaches, spend money on training instructors to teach across courses, and make sure that their curricula include both technical and creative abilities to equip pupils ready for the difficulties of the 21st century.

Evaluation

There is still a lot of research that needs to be done on the intersection of English Language Acquisition (ELA) and STEAM-based learning environments that use Content and Language Integrated Learning (CLIL) principles. This is despite the fact that more and more research is showing the benefits of STEAM education and how it can help students learn in a creative and interdisciplinary way. There are a number of studies that look at language learning or STEAM integration by itself, but not many that look at how doing STEAM projects that are analogous to real-life scenarios that are rich in content and demand a lot of thinking might help one learn English. This gap is especially obvious because there aren't many real-world studies that apply CLIL's dual-focus strategy, which involves learning both material and language at the same time, in immersive, project-based contexts that are typical in STEAM education.

4. Statement of the Problem

The review done from the available relevant literature, relating to the present research area, led the investigators to conceptualize the problem in an attempt to fill the void found. Thus, the problem is stated as here under:

5. Objectives of the Study

The objectives of the present study are:

- (i) To prepare a plan of action to teach using Content and Language Integrated Learning in a STEAM based environment for students of Standard IX;
- (ii) To investigate the possible relationship between the independent variables, scientific temper and student engagement and the dependent variable, English Language Acquisition;
- (iii) To investigate the possible significant difference between the pre-test scores of the independent variables scientific temper and student engagement and dependent variable English language acquisition among students of standard IX in the Control and Experimental groups;
- (iv) To investigate the possible significant difference between the pre and post-test scores of English language acquisition among standard IX students in Control and Experimental groups; and
- (v) To investigate the possible significant difference between the post-test scores of the independent variables scientific temper and student engagement and the dependent variable English language acquisition among students of standard IX in the Control and Experimental groups

6. Hypotheses

- (i) There will be a significant relationship between independent variables scientific temper, student engagement and the dependent variable English Language Acquisition.
- (ii) There will be no significant difference between the pre-test scores of scientific temper, student engagement and English Language Acquisition in Control Group and Experimental Groups.
- (iii) There will be no significant difference between the pre and post -test scores of scientific temper, student engagement and English Language Acquisition in Control Group.
- (iv) There will be no significant difference between the pre and post-test scores of English language acquisition among standard IX students in Experimental Group and

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- (v) There will be no significant difference between the post-test scores of English language acquisition among standard IX students in Control and Experimental Groups.

7. Method of Investigation

The present study deals with the analyses of pre and post test scores of the experimental and control groups where the intervention is given to the experimental group for a period of 30 days and traditional method of instruction is given to the controlled group with respect to Scientific Temper scale, Student Engagement scale and English Language Acquisition for Standard IX students.

7.1 Population and sample Characteristics

The investigator selected students of Class IX from a government-aided Girls Higher Secondary School, Chennai district for the experimental study (32 students as experimental group and 32 students as control group). The English medium students of standard IX following the Tamil Nadu state board syllabus were selected. For validation of the tools, the investigator selected experts from various field. The experts include teacher educators, Science and English teachers from higher secondary school, teachers from government, aided and unaided sectors, comprise both of male and female experts.

7.2 Tools used for study

The variables chosen for the present study necessitated both selection and construction of relevant tools. The tools selected to be used for assessment of the variables are as follows:

- (i) Scientific Temper scale (Tiwari and. Pande, 2006), Adapted and modified by the investigators.
- (ii) Student Engagement scale (Chiu et al., 2006), Adapted and modified by the investigators.
- (iii) English Language Acquisition (Developed by the Investigators)

Analyses of Data

The result of the analyses of data collected are compiled and presented in the tables below:

Statistical analyses will be based on the hypotheses formulated for the present study. It is predicted to be multivariate statistical analyses as the study includes multiple variables.

Table-1: Simple Correlation Matrix between Independent Variables and English Language Acquisition among Standard IX Students (N=64)

Variables	Scientific Temper	Student Engagement	English Language Acquisition
Scientific Temper	1	0.47**	0.81**
Student Engagement	X	1	0.54**
English Language Acquisition	X	X	1

**Significant at 0.01 level

From the above table (Table-1), it is evident that the select variables of the present study, namely scientific temper, student engagement and English language acquisition are positively correlated with each other and significant at 0.01 level.

Table-2: Statistical Analysis of Means of Pre-test Scores of Scientific Temper, Student Engagement and English Language Acquisition among Standard IX Students in Experimental and Control Groups

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Scientific Temper	Control Group	32	57.28	9.79	1.73	2.59	0.20	0.84 ^{NS}
	Experimental Group	32	57.81	10.9	1.93			
Student Engagement	Control Group	32	33.95	6.98	1.23	1.68	0.46	0.65 ^{NS}
	Experimental Group	32	33.18	6.43	1.14			
English Language Acquisition	Control Group	32	57.50	9.88	1.75	2.66	0.26	0.79 ^{NS}
	Experimental Group	32	58.19	11.36	2.01			

NS-Not Significant

On comparing the pre-test scores of the experimental and control groups of standard IX students it is seen that the pre-test scores of the experimental group and the control group are found to be not significant in all two independent variables namely scientific temper and student engagement and the dependent variable English Language Acquisition.

Table-3: Statistical Analysis of Means of Pre and Post-test Scores of Scientific Temper, Student Engagement and English Language Acquisition among Standard IX Students in Control Group

Variable	Pre and Post Test Scores	N	Mean	SD	SEM	SED	CR	Level of Significance
Scientific Temper	Pre-test	32	57.28	9.79	1.73	2.62	1.37	0.17 ^{NS}
	Post-test	32	60.88	11.13	1.97			
Student Engagement	Pre-test	32	33.95	6.98	1.23	1.69	0.39	0.69 ^{NS}
	Post-test	32	34.62	6.50	1.15			
English Language Acquisition	Pre-test	32	57.50	9.88	1.75	2.64	1.16	0.25 ^{NS}
	Post-test	32	60.56	11.24	1.99			

NS-Not Significant

On comparing the pre and post-test scores of the control groups of standard IX students it is seen that the pre-test scores are found to be not significant in both the independent variables namely scientific temper and student engagement and the dependent variable English Language Acquisition.

Table-4: Statistical Analysis of Means of Pre and Post-test Scores of Scientific Temper, Student Engagement and English Language Acquisition among Standard IX Students in Experimental Group

Variable	Pre and Post Test Scores	N	Mean	SD	SEM	SED	CR	Level of Significance
Scientific Temper	Pre-test	32	57.81	10.89	1.93	2.59	2.41	0.19 ^{NS}
	Post-test	32	64.06	9.77	1.73			
Student Engagement	Pre-test	32	33.18	6.43	1.14	1.72	3.83	0.001 ^{**}
	Post-test	32	39.79	7.33	1.30			
English Language Acquisition	Pre-test	32	58.19	11.36	2.01	2.58	3.11	0.005 [*]
	Post-test	32	66.19	9.12	1.61			

NS-Not Significant****Significant at 0.01 level*****Significant at 0.05 level**

On comparing the pre-test scores of the experimental groups of standard IX students it is seen that the scores are found to be not significant in the independent variables namely scientific temper but significant for the independent variable student engagement and the dependent variable English language acquisition. The results indicate that the intervention or treatment provided to the experimental group of standard IX students has had a positive impact.

Table-5: Statistical Analysis of Means of Post - test Scores of Scientific Temper, Student Engagement and English Language Acquisition among Standard IX Students in Control Group and Experimental Groups

Variables	Groups	N	Mean	SD	SEM	SED	CR	Level of Significance
Scientific Temper	Control Group	32	60.88	11.13	1.97	2.61	1.22	0.23 ^{NS}
	Experimental Group	32	64.06	9.77	1.73			
Student Engagement	Control Group	32	34.62	6.50	1.15	1.73	2.98	0.001 ^{**}
	Experimental Group	32	39.79	7.33	1.30			
English Language Acquisition	Control Group	32	60.56	11.24	1.99	2.56	2.20	0.005 [*]
	Experimental Group	32	66.19	9.12	1.61			

****Significant at 0.01 level*****Significant at 0.05 level****NS-Not Significant**

On comparing the post-test scores of the control group and Experimental groups of standard IX students, it is seen that the mean of post-test scores of the experimental group is found to be higher in the independent variable student engagement and also in the dependent variable English language acquisition. It is evident that there is no significant difference between the pre- and post-test scores of Scientific Temper, while a significant difference is seen in both the cases of student engagement and English language acquisition among standard IX students in control and experimental groups.

8. Discussion

The present study explored the relationship between Scientific Temper, Student Engagement, and English Language Acquisition among Standard IX students, and examined the impact of a CLIL–STEAM-based intervention on these variables. The correlation results (Table 1) revealed that all three variables were positively correlated and significant at the 0.01 level, with Scientific Temper showing a strong correlation with English Language Acquisition ($r = 0.81$) and a moderate correlation with Student Engagement ($r = 0.47$), while Student Engagement correlated moderately with English Language Acquisition ($r = 0.54$). This pattern indicates that students who display higher levels of curiosity, rationality, and open-mindedness (dimensions of scientific temper) also tend to exhibit greater engagement in learning and stronger English proficiency. These findings support the theoretical underpinnings of Vygotsky's (1978) sociocultural theory, which emphasizes the significance of social interaction and learner engagement in cognitive and linguistic development.

Table-5 further confirmed the significant difference between the post-test means of the experimental and control groups in Student Engagement ($CR = 2.98$, $p < .01$) and English Language Acquisition ($CR = 2.20$, $p < .05$), reinforcing the positive effect of the intervention. Although Scientific Temper did not show a statistically significant difference, the consistent increase in its mean suggests that cognitive dispositions such as rationality and openness to evidence may require longer and sustained exposure to inquiry-based learning contexts to manifest significantly. Overall, these findings validate that integrated pedagogical models like CLIL–STEAM can substantially enhance learner engagement and language proficiency, while gradually nurturing scientific temper. The results corroborate earlier research by Mehisto, Marsh, and Frigols (2008), who emphasized that CLIL environments not only enhance linguistic competence but also promote higher-order thinking, motivation, and self-regulation. Hence, it can be concluded that a CLIL–STEAM-based learning environment effectively bridges the cognitive, behavioural, and linguistic domains, fostering meaningful and holistic educational outcomes that traditional approaches may not achieve within the same time frame.

9. Conclusion

Overall, the study demonstrated that scientific temper, student engagement, and English language acquisition are positively interrelated. The CLIL–STEAM intervention significantly enhanced student engagement and English language acquisition, while also promoting gains in scientific temper. By situating language learning within the context of scientific inquiry, the intervention effectively fostered both academic achievement and holistic development. These findings contribute to growing evidence that interdisciplinary, integrated pedagogical models are not only effective but necessary in preparing students for the demands of the 21st century.

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